5/parts

PATENT SPECIFICATION

DRAWINGS ATTACHED

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International Classification:—**B05. B23p. F06c.**

COMPLETE SPECIFICATION

Improvements in Wear-Resistant Elements for Bearing Surfaces and the manufacture thereof

I, SIDNEY LOW, a Citizen of the United States of America, of 71, Springfield Street, Wilbraham, County of Hampden, State of Massachusetts, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the provision of improved wear-resistant elements for purposes of increasing the wear-resistance of contacting relatively movable parts. More particularly, the improved elements are useful in journal bearings and thrust washers in flat elements having mutual sliding contact.

The invention has particularly suitable characteristics for mechanical applications in the case of bearings and similar movable components such as a Fourdrinier screen as used in a paper-making machine, where heat dissipation and/or proper lubrication present serious problems.

The invention provides a method of making a wear-resistant element for a bearing surface, in which a perforated or foraminous metallic backing layer is first coated with a layer of polytetrafluorethylene and is then coated with one or more further layers of polytetrafluorethylene.

The resultant elements permit effective operation of mutually sliding parts without the use of, or in the temporary absence of, an intermediate separating film of oil or equivalent lubricant. This is particularly desirable where the heat in the region concerned may destroy the lubricant or where access to grease fittings is difficult if not impossible.

Herein, the excellent friction, chemical, and wear properties of certain plastics are combined with the strength, thermal conductivity, and dimensional stability of certain metals, all to the end that an improved wear resisting surface for a relatively movable component of a machine or the like is produced.

In certain prior art practices, parts must be made from special metals in order to obtain the requisite wear resisting surface. The objections often present themselves either that the metal to be employed is relatively expensive or that the desired degree of hardness and/or depth thereof is/are difficult to obtain.

In accordance with this invention, a relatively thin, perforated metal material may be employed, or if desired, a relatively thin metallic mesh material may be employed with equally effective results. In either case, the material employed is such as to be sufficiently pliable or bendable so as to be adapted to conform to the contour of the object upon which it is to be used. Also, in either case, the material is such as to offer a multiplicity of relatively small openings or interstices therethrough.

As one example, perforated metal of 16 or 18 gauge and having rather closely spaced openings or holes therethrough has been found to be especially adapted for the invention. The same is relatively soft as distinguished from a hardened metal and may be readily cut to the desired shape and formed to the desired contour. It will be understood however, that plated or surface hardened material may be employed, if desired.

As another example, a woven wire mesh may be employed. Optimum results are obtained where the mesh ranges from 0.010″ to 0.100″ in thickness. Thinner, and even thicker, materials may be used, if desired. The wire such as is used in the Fourdrinier of a paper-making machine, is especially well suited for the purpose of this invention.

A typical wire cloth employed in this invention is made of wear-resistant phosphor bronze, alloy warp and fill wires of 0.15″ diameter (35 mesh per inch). Wires of stainless

[*Price 3s. 6d.*]

Price 4s 6d

Price 25p

Price 33p

Price 33p

steel, silver or equivalent materials can likewise be employed.

The said layers may be applied by dipping the metallic element in the plastic material. It will be understood however, that the layers may be sprayed, calendered, or doctored on to the metal material with equally efficient results.

The thickness of the intermediate layer can easily be controlled by conventional methods so as to provide a coating of a few thousandths of an inch in thickness or of any other desired thickness.

It should here be stated that the plastic coating material may have dry lubricants added thereto, if desired. As an illustration, molybdenum bisulphide may be added to the epoxy resin. However, such practice is not often necessary.

The resultant surfaced metal or wire cloth, having the said layers, is flat and smooth and is suitable for many applications without further processing. The material can be readily cut to any desired shape and size using conventional metal cutting shears, nibblers, blanking dies, or the like.

If desired, however, an outer surface of the improved wear-resistant element may be abraded so as to present a smooth surface to which a thin material may be soldered or welded or otherwise bonded or mechanically fastened. Such an abrading procedure may be necessitated by the fact that it is sometimes difficult, if not impossible, to adhere another material directly to the plastic coating by means of an adhesive.

The metal points of the wire (about 5000 per square inch) take wear along the wear plane and the plastic points therebetween provide a lubricant to the system. Here, it is not a question of employment of a weak plastic; rather, it is a question of employment of a strong metal at the wear plane.

The metal is of high heat conductivity in itself and provides the heat conductivity paths along which the heat may be drawn away.

Whether the combined metal and plastic are used in their initial form wherein the plastic is dipped or otherwise coated thereon, or in their fabricated form wherein the plastic coating is abraded on one surface thereof, the material is then ready for bonding to the bearing surface which is to be protected against wear. Such surface may be a metallic plate and securement thereto may be by means of an adhesive a similar bonding material.

In certain cases, a lubricant may be incorporated into the bonding agent or may be added directly to the wear-resistant material.

For bearing applications, polytetrafluorethylene when used by itself is limited to light loads and low speeds due to its exceptionally poor thermal conductivity, its poor temperature stability, its high coefficient of thermal expansion, its tendency to cold flow and its elastic memory. Otherwise polytetrafluorethylene possesses good anti-friction properties for use with steel or other usual journal materials and has the capacity for retaining these properties in the absence of an intermediate separating film of oil or other lubricant.

The aforementioned disadvantages render polytetrafluorethylene in and by itself as unsuitable for successful application to a majority of bearing problems, especially where severe load conditions are experienced.

This invention envisions the utilization of the good anti-friction properties of the plastic while at the same time surmounting the said disadvantages.

Polytetrafluorethylene is a long straight chain polymer consisting of carbon and fluorine only. It is produced by E. I. du Pont de Nemours under the Registered Trade Mark "Teflon". It has remarkable chemical properties and a dry coefficient of friction against itself or any other material of about 0.05 which is roughly equivalent to that obtained between two pieces of smooth ice. This low friction is a surface property of the material and is not a measure of its shear strength as is the case with some solid lubricants. Therefore almost no wear takes place when a smooth surface is rubbed against a smooth piece of the plastics. Any wear which takes place is due solely to the roughness of the mating surface ploughing through the resin surface. Pits and discontinuities making up the roughness should in time become filled with the resin and wear would be reduced even further.

When associated with a metal backing, be it a solid metal plate or a woven wire mesh, the capacity of the plastic for carrying off heat generated during service is immeasurably improved, not to mention the improved, support and dimensional stability so lacking in the plastic *per se*. Too, the plastic material offers the advantage of requiring no lubricant and it is not affected by the temperatures encountered.

Load and speed capacities of bearings are determined largely by the capacity of the assembly to dissipate heat. In the normal prior art bearings, liquid lubricants are employed to remove heat from the contacting surfaces. With the wear-resistant elements of this invention, where liquid lubricants or coolants are not necessitated, heat generated is dissipated through the metallic backing.

For a constant bearing pressure (P in psi) and surface speed (V in fpm), constant bearing conditions can be anticipated. Heavy loads can be carried at low surface speeds and light loads can be carried at high surface speeds.

The following table of PV factors is based on tests which I have made on bearings operating against steel shafts with good surface finish under conditions ranging in pressure from 5 to 2000 psi and at surface speeds of from 10 to 500 fpm:—

Unlubricated bearing, mild steel shaft	PV
Journal bearing, unidirectional load -	16000
Journal bearing, rotating load - -	30000

In the above table, the PV factor represents the unit load on the projected area (psi) at a velocity (fpm). The PV factors shown are substantially applicable at surface speeds up to around 500 fpm. At higher speeds, air tends to be sucked in between the bearing and the mating surface and acts as a lubricant allowing higher loads to be carried.

Certain shaft materials such as alloy steels, cast irons, or hard anodized aluminums permit higher PV factors. The PV values can be raised considerably by coating the shaft with lead or chromium plate, a plastic resin, or molybdenum disulphide.

Maximum use temperature for the impregnated bearings of this invention approximates 600° F. However, for most applications, ambient temperatures up to 500° F. are suitable. Proper cooling of the bearing surface permits the raising of this temperature.

Though the bearing material of this invention is designed for operation without a liquid lubricant, the pressure of a suitable liquid in most cases will increase the rate of heat dissipation and will permit more severe operating conditions.

Liquids, such as water, acids and solvents are not objectionable or harmful to the bearing surface. However, in view of the metal backing element, care must be taken in the selection of the liquid. Further, consideration must be given to the selection of the liquid for the reason that all fluids will not wet plastic surfaces and thus will not be readily drawn between the bearing surfaces. Nonetheless, the exposed metal wear points in the wear plane may be wetted by many lubricants so as to provide a distinct advantage over the use of plastics alone.

In certain instances, it may be desirable to employ more than a single layer of perforated metal or woven wire cloth.

As another variation in the practice of the invention, circumstances may require the bonding of the perforated metal or woven wire cloth to the bearing surface before the application of the plastic material. In such event the interstices of the metallic backing element and the surface thereof are covered with the intermediate and outer layers of plastic subsequent to the bonding operation.

For purposes of further illustration by means of which the structure and relative arrangement of parts thereof may be better shown and described, the invention will now be more fully described and referred to in conjunction with the accompanying drawings wherein:—

Fig. 1 is a partial top plan of a sheeting of perforated metal showing the plastic coating associated therewith;

Fig. 2 is a sectional elevation on the line 2—2 of Fig. 1;

Fig. 3 is a partial top plan of a woven wire screen showing the plastic coating associated therewith;

Fig. 4 is a sectional elevation on the line 4—4 of Fig. 3, and

Fig. 5 is a sectional elevation similar to Fig. 4 showing the structure after wear has occurred.

Referring now to the drawing in more detail, in which similar characters of reference indicate corresponding parts in the several figures, and referring more particularly to the preferred form of my invention selected for illustrative purposes, I have shown in Figs. 1 and 2, a perforated metal sheet 10 in order that the general relation and utility of the construction may be better understood. The metal sheet 10 is relatively thin, having a multiplicity of relatively small openings or perforations 12 therethrough.

The metal is dipped in or is otherwise suitably covered with the wear resistant polytetrafluorethylene coating 14. The covering 14 is applied first as a single layer over the surface of the metal and then with a second layer laminated on to the first so as to provide the desired thickness thereof.

Certain of the plastic coating material passes inwardly through the openings or interstices 12 so as to fill the same. If desired, the construction can thereupon be bonded to a suitable backing plate 16 by means of a weld 18 or by equivalent securing means.

In Figs. 3 and 4, I have shown in greatly magnified views a metallic wire mesh or woven wire cloth comprising a multiplicity of warp wires 20 which may be of phosphor bronze, silver or the like, and a multiplicity of weft wires 22 running transverse thereto in the conventional manner. The weft wires may likewise be of phosphor bronze, silver or the like.

The wear resistant plastic 24, made up of two layers may be coated or otherwise flowed on to only one surface of the wire cloth. Said plastic may be with or without a dry lubricant added thereto. The plastic has the capacity to flow into the interstices between the crossing warp wires and weft wires so as to more or less surround most surfaces thereof.

In the case of a Fourdrinier wire the plastic material is preferably sprayed on so as not completely to fill the interstices between the crossing wires. Since all of the wires are coated or covered, there is, of course, plastic-to-plastic contact between the wires.

If desired, the surface of the wire cloth opposite to the surface which is coated, may be roughened by abrasion or other mechanical means. In to the same, a solder or similar bonding agent 25 may be flowed so as to provide an improved bonding means by which a

metallic backing plate 26 may be secured to the woven cloth.

In Fig. 5, I have shown one form of the material as illustrated in Figs. 3 and 4 after wear has taken place. After minor initial wear, the resulting structure is observed to comprise a mechanically interlocked net work of metal and plastic along the wear plane designated by numeral 30.

WHAT I CLAIM IS:—

1. The method of making a wear-resistant element for a bearing surface, in which a perforated or foraminous metallic backing layer is coated with a first layer of polytetrafluorethylene and is then coated with one or more further layers of polytetrafluorethylene.

2. The method of Claim 1, wherein the said first layer is caused to fill the openings in the metallic backing layer.

3. The method of Claim 1 or 2, wherein the metallic backing layer is a woven wire mesh.

4. The method of Claim 1, 2 or 3, wherein the said first and further layers are applied to one side only of the metallic backing element.

5. The method of producing a wear-resistant material substantially as herein set forth.

6. A wear-resistant element produced by the method of any of the preceding claims.

7. A wear-resistant element according to Claim 6 and substantially according to either of the particular embodiments herein described with reference to the accompanying drawing.

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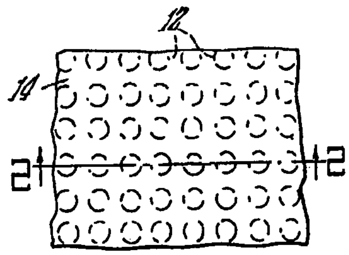
821,472 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

Fig.1.



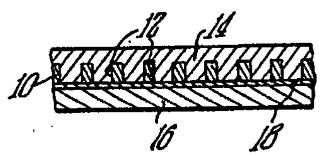
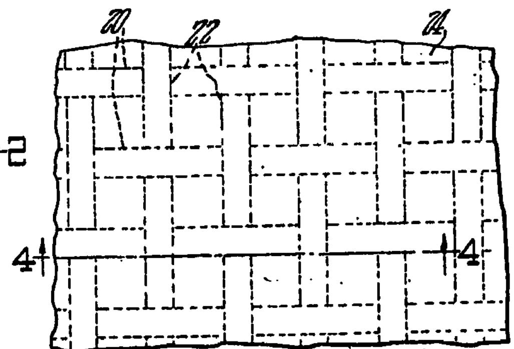


Fig.2.

Fig.3.



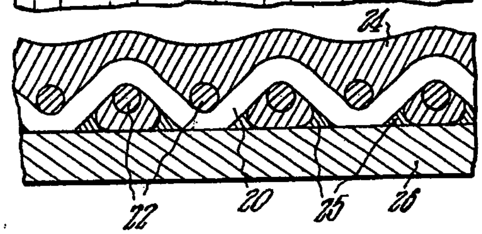


Fig.4.

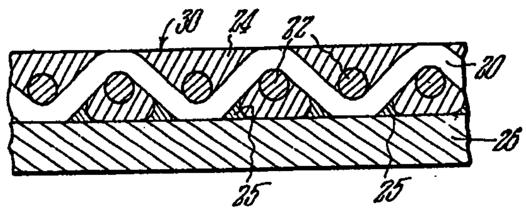


Fig.5.

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